# ULTRA-STABLE STRUCTURE

Completed Technology Project (2014 - 2018)

## Project Introduction

A potential follow-on to the James Webb Space Telescope is a Large Ultraviolet-Optical Infrared (LUVOIR) space telescope with an aperture in the range of 10-12m or larger. LUVOIR would conduct a spectroscopic survey for evidence of life in potential habitable earth-like planets, and provide an observatory for ground-breaking astrophysical programs. A 10-12 m class UVOIR observatory has been recommended by AURA's Beyond JWST committee in presentations made to the AAS. In considering the key technology challenges of such a mission, it is important to point out that the survey of earth-like candidates requires high contrast (10^10) combined with small Inner Working Angle (IWA) coronagraphs (2 L/D) , and the ability to survey hundreds of G and K type stars during the mission lifetime (Stark et al. 2014). To achieve this level of contrast, the observatory will need to efficiently achieve stability levels across the primary mirror less than 10 picometers for up to 10 minutes (Redding et al, 2014). Our team has shown through modeling that meeting the stability requirement of lightweight mirror segments of 1.2m diameter lightweight hexagonal shape Ultra Low Expansion (ULE) mirrors is feasible using achievable thermal control approaches at room temperature with 1 milli-Kelvin level thermal control and work is ongoing to assess mirror level thermal stability. However, another key capability required to enable this level of system performance is achieving segment to segment stability (Feinberg, et al 2014), which is driven by the mirror support structures (if each segment is already stabilized with an appropriate thermal control system). Therefore, our team proposes an approach that combines improved composite materials and structures, innovative mirror mounting, active thermal strategies, and optical measurement methods to demonstrate a segment to segment thermal and dynamic stability of 10 picometers over up to 10 minutes on a subscale system. The composite material improvements are in reduced moisture absorption effects (CME) and CTE based on nanotechnology. To achieve this, we will leverage etalon based coupon level test methods developed by the LISA community, high speed interferometry dynamic and electronic speckle pattern interferometry for thermal stability metrology developed by the JWST community. This work will provide an alternative (and potentially more robust method) for building dimensionally stable systems for precision measurements such as detection gravitational waves.


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## Organizational Responsibility

**Responsible Mission Directorate:**

Science Mission Directorate (SMD)

**Lead Center / Facility:**

Goddard Space Flight Center (GSFC)

**Responsible Program:**

Strategic Astrophysics Technology

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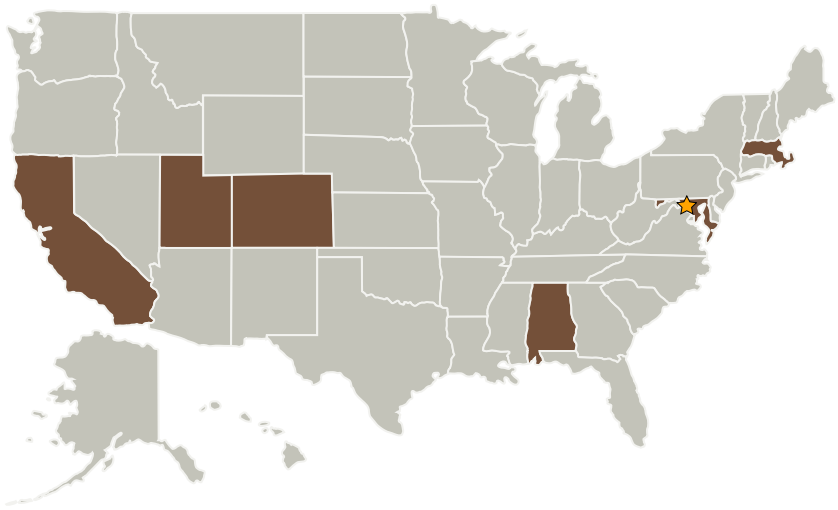
## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| ★Goddard Space Flight Center(GSFC) | Lead Organization | NASA Center | Greenbelt, Maryland |

| Primary U.S. Work Locations | |
|---|---|
| Alabama | California |
| Colorado | Maryland |
| Massachusetts | Utah |

## Project Management

**Program Director:**

Mario R Perez

**Program Manager:**

Mario R Perez

**Principal Investigator:**

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**Co-Investigators:**

Jeffrey C Livas
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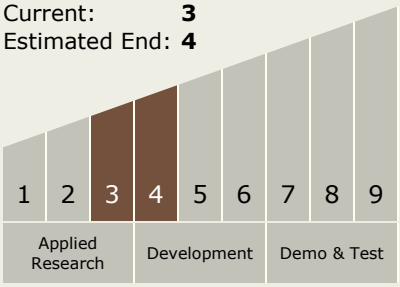
David M Chaney
Marie B Levine
David T Leisawitz
Mark Clampin
Lester M Cohen

## Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **4**




## Technology Areas

**Primary:**

*Continued on following page.*

## Technology Areas *(cont.)*

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.2 Structures and Antennas

## Target Destination

Outside the Solar System